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(54) Respirators

(57) A power assisted positive pressure respirator includes a power driven pump assembly (7) with an air filter unit (10). An impeller (15) with radial blades (17) is located axially within the pump assembly housing, (8, 9) and co-operates with a coaxial fixed vaned diffuser (18). The impeller is driven by a motor (14) mounted in a housing by three struts (20) which are at an angle with respect to the impeller vanes to reduce the blade passing frequency whistle to a minimum. A power pack comprising a number of nickel cadmium cells are sealed within a belt (21, Figs 5, 6) strapped around the wearer's body to provide a power supply to the motor (14). The belt has a metal buckle and buckle pin (28, 29, Fig. 7) which are wired to the battery cells and act as charging contacts.

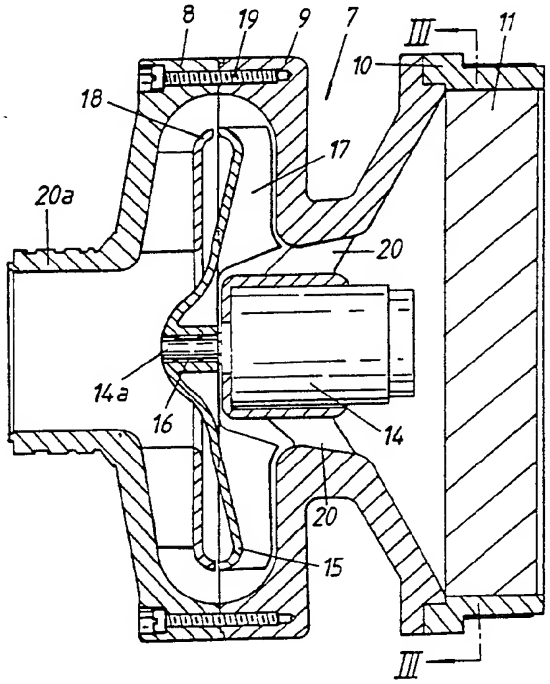

FIG.2.

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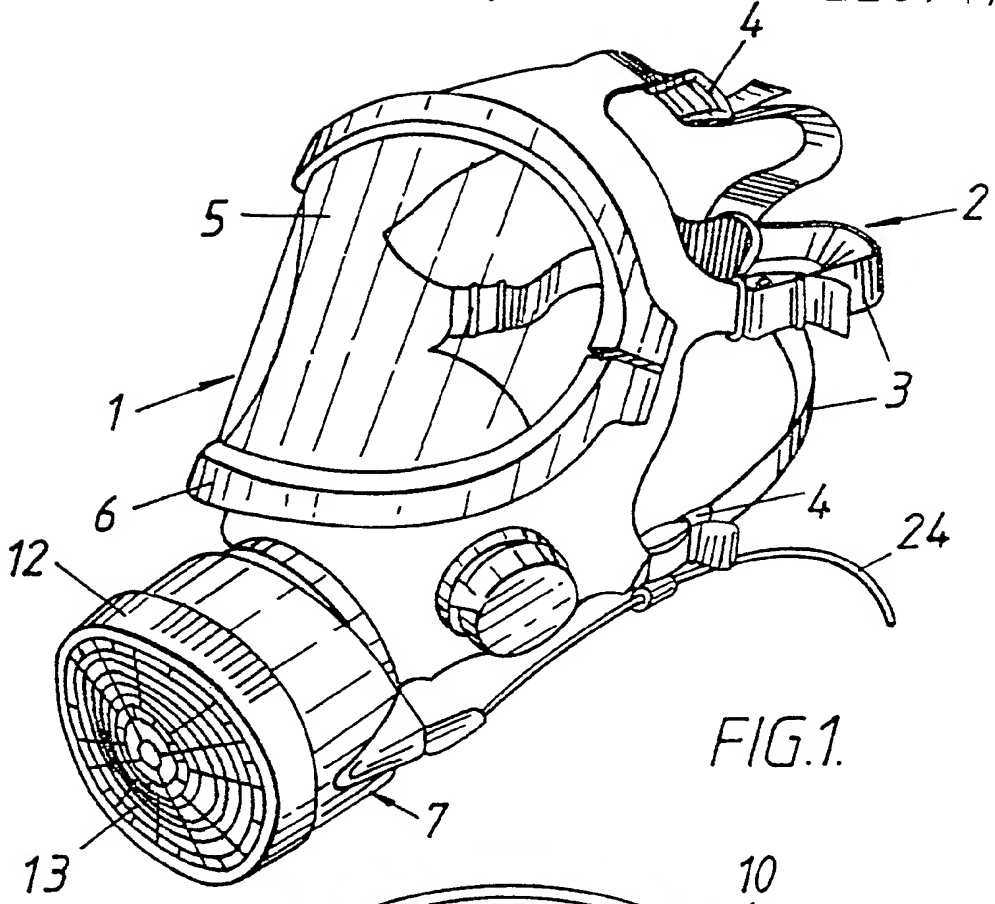

FIG.1.

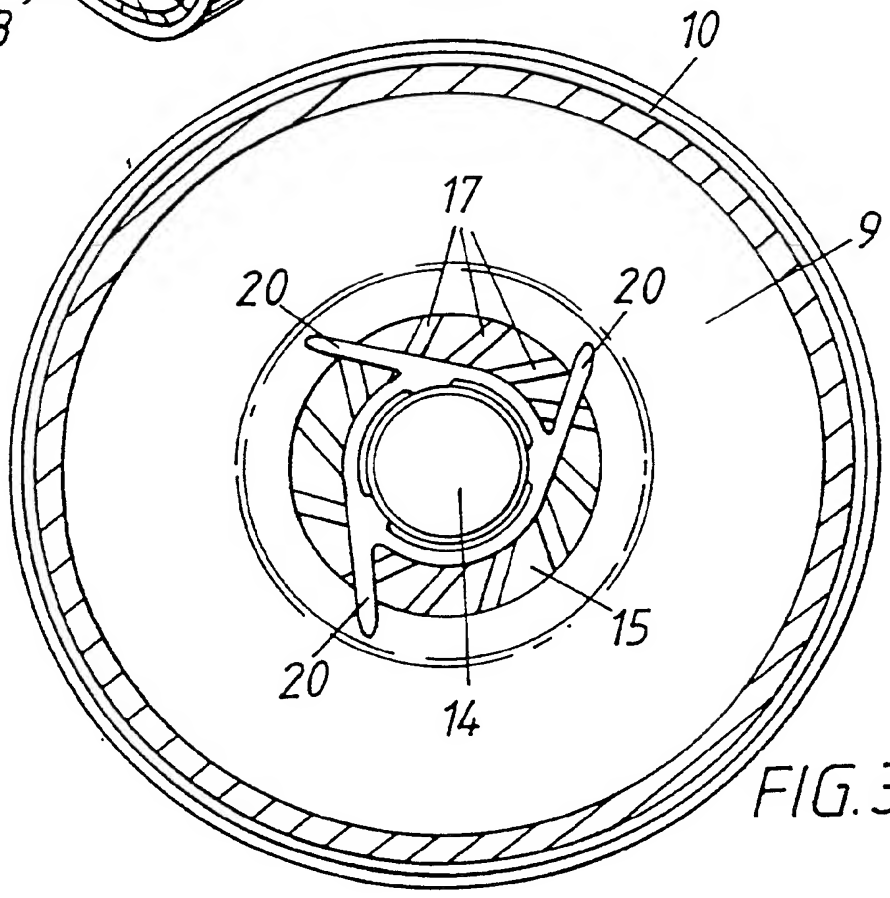

FIG.3.

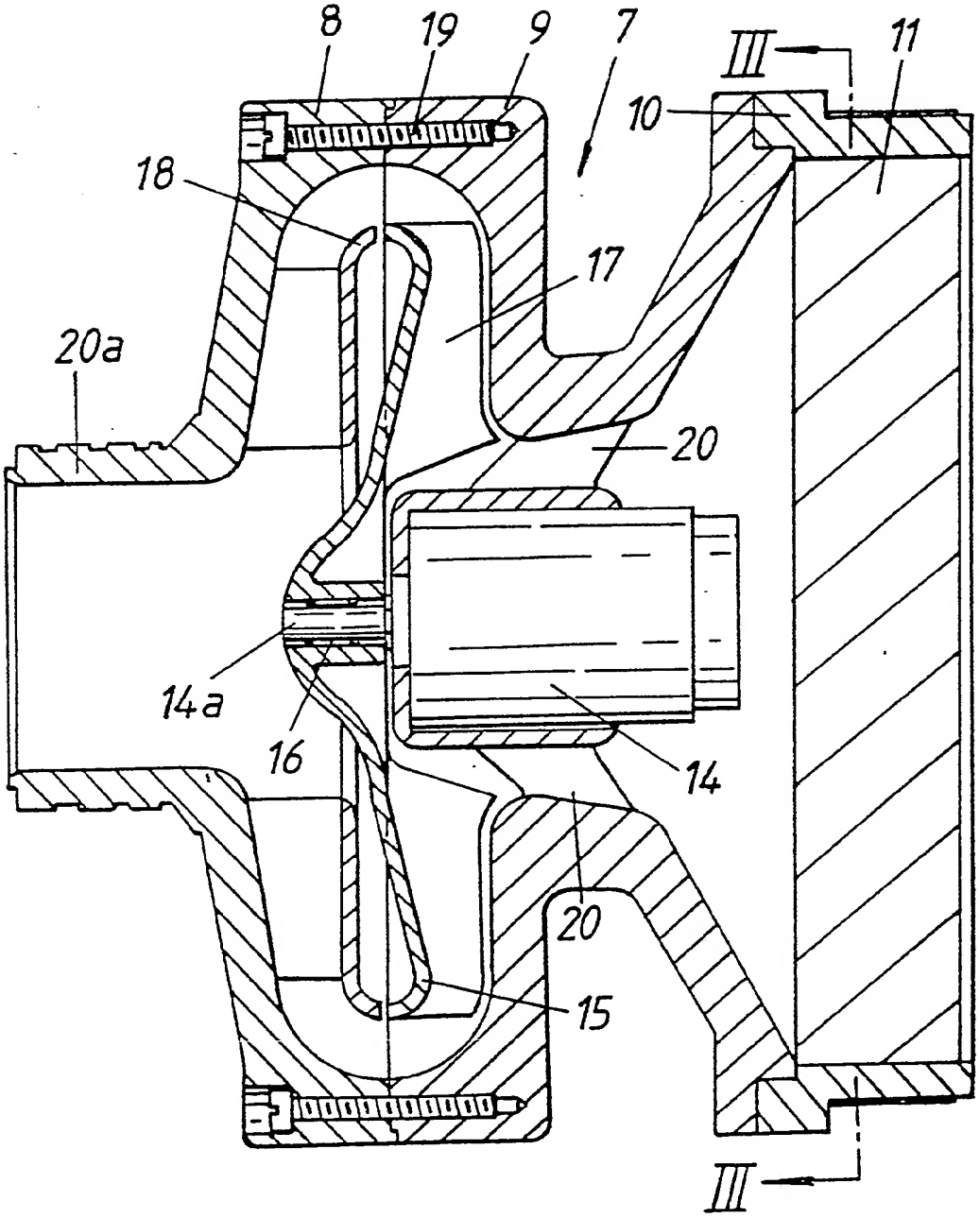

FIG.2.

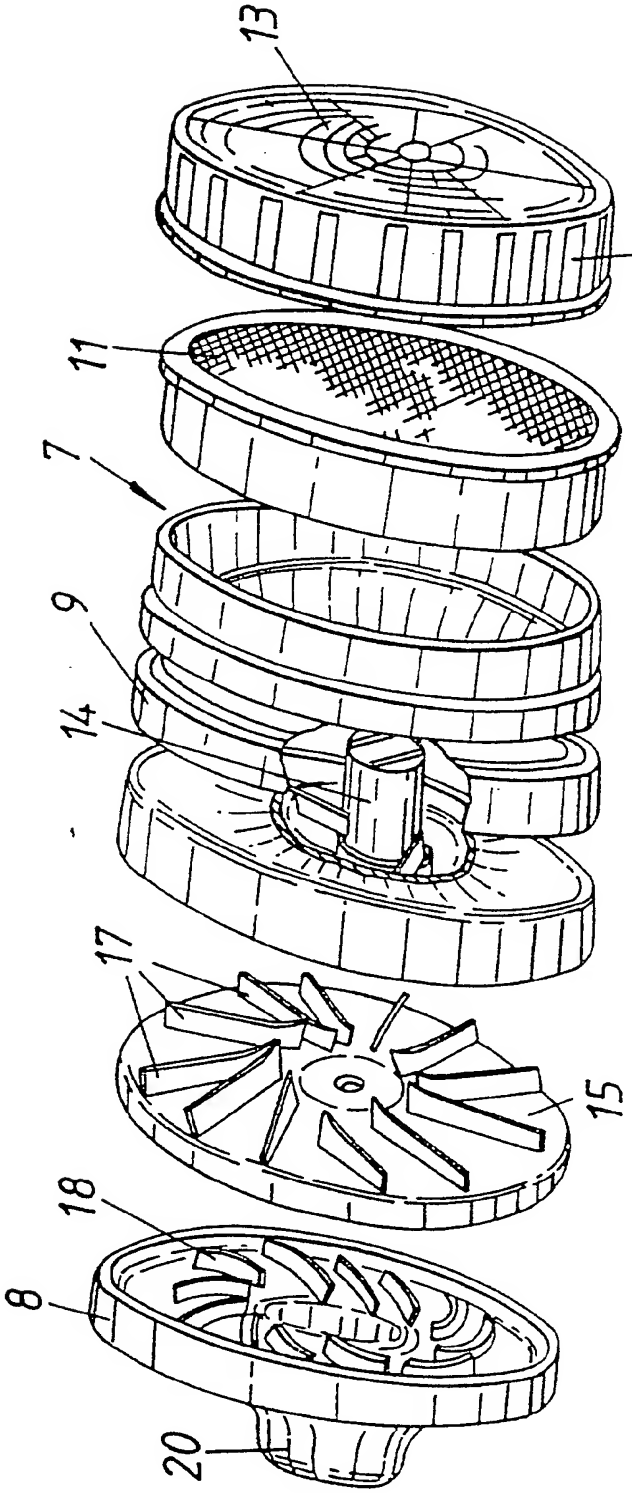

FIG.4.

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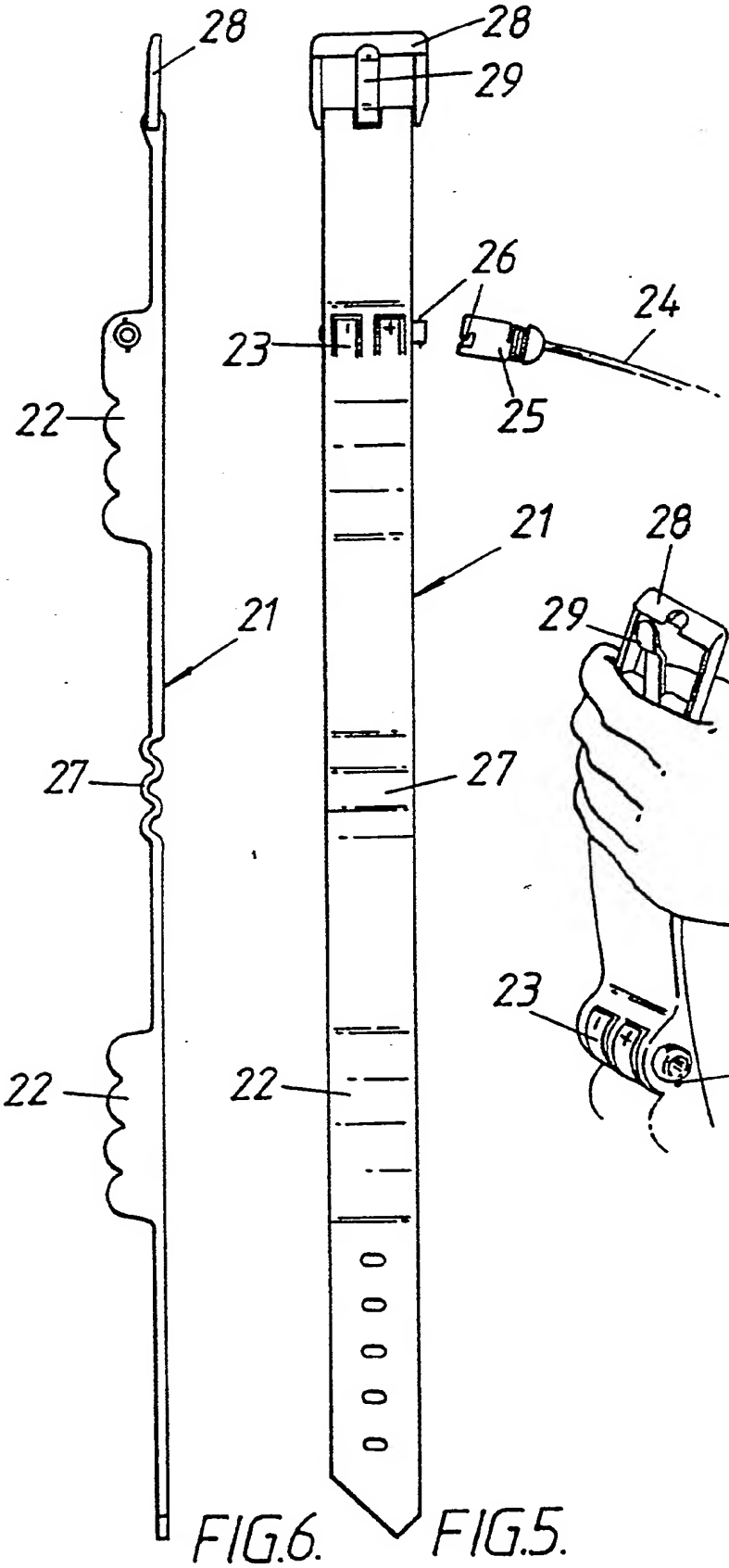

FIG.6. FIG.5.

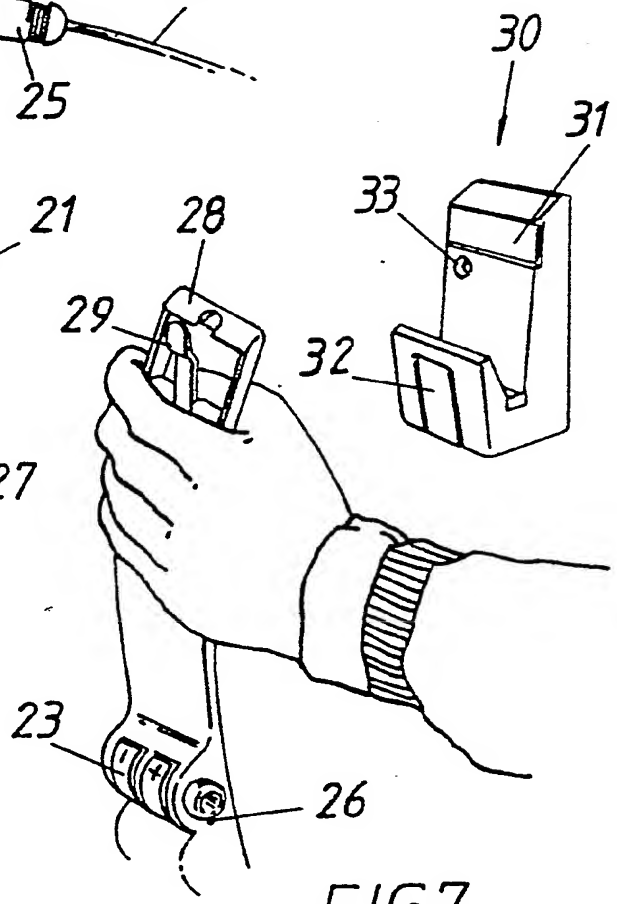

FIG.7.

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'Improvements relating to Respirators'

This invention relates to respirators and more particularly to power assisted positive pressure respirators of the type comprising a face mask either a half mask covering the mouth and nose of the wearer or alternatively a full face mask covering the mouth nose and eyes of the wearer.

Various power assisted face masks respirators are known which include a filter, for filtering the air through the filter into the mask, and a pump to assist the flow of air through the filter into the mask to be inhaled by the wearer.

These known respirators have the disadvantage that the fan unit in the pump is powered by a small axial flow fan and in order to maintain the minimum pressure required to meet existing safety standards the fan must run at high speed at approximately 20, 000 revolutions per minute . The high running speed of this fan consequently make them noisy and cause discomfort to the wearer.

An aim of the present invention is to overcome this disadvantage by providing a power assisted positive pressure respirator having a centrifugal impeller which is relatively slow moving while maintaining the necessary air flow to the wearer.

According to the present invention there is provided a power assisted positive pressure respirator of the type set

forth, comprising an air filter unit and a power driven pump, wherein the pump includes a fixed vaned diffuser coaxial to and co-operating with a centrifugal impeller such that the noise of the power driven pump is reduced to a minimum acceptable within operational safety requirements.

Preferably the pump comprises a diffuser fixed to the impeller housing and a rotary impeller driven by a motor located axially within the impeller housing.

Conveniently, the impeller has a plurality of radially extending blades.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which,

Figure 1 is a perspective view of a power assisted respirator, according to the present invention;

Figure 2 is a axial section of the filter and power driven pump assembly;

Figure 3 is a cross section taken along the line III - III of Figure 2;

Figure 4 is an exploded perpective view of the filter and power driven pump assembly;

Figure 6 is a plan of the belt for supporting a battery pack;

Figure 7 is a fragmentary perpective view of the buckle end of the belt, shown in Figures 5 and 6, for supporting on a charging unit to recharge the batteries.

The power assisted respirator is of the positive pressure

type to allow the respirator to function should the motor driven impeller fail to operate. The respirator comprises a facepiece 1 having a harness 2 for fitting in an airtight manner to the head of the wearer by adjustable straps 3 and buckles 4. The flexible face piece 1 has a visor 5 sealed to it by a reinforced solid rubber portion 6. Mounted on the front of the facepiece is a power driven pump assembly 7. With particular reference now to Figures 2 to 4 the power driven pump assembly 7 comprises an impeller housing assembled in two parts 8 and 9 and a filter unit generally indicated at 10 secured to the impeller housing. The filter unit contains a replaceable filter 11 and is closed by a screw cap 12 formed with a grill 13.

The assembly 7 is driven by a motor 14 rigidly secured in the housing part 9. The motor 14 is located in the inlet of the airflow path cooling the motor. Rotatably mounted on the spindle 14a of the motor is an impeller 15 with the interposition of a 'RENCOL' tolerence ring 16. The impeller is moulded from a plastics material with a plurality of radial blades 17 and co-operates with a fixed coaxial diffuser having a plurality of curved ribs 18 integrally moulded with the impeller housing part 8. The two parts 8 and 9 of the impeller housing are secured in an air tight connection by e.g. six threaded screws (see Figure 2). The motor driven impeller rotates at between 7,500 and 9,000 revolutions per minute.

The impeller housing part 8 is integrally formed with a threaded tube 20a for screwing the power driven pump assembly

7 into a rigidly moulded portion of the facepiece 1 so that it is positioned close to the mouth and nose of the wearer providing a minimum air flow passage within the face mask. The cross-section shown in Figure 3 illustrates the mounting of the motor 14 by means of three angled support struts 20. These motor support struts are very important as the wakes from the support struts will be responsible for a significant part of the blade passing frequency whistle which will inevitably come from the fan. Depending on the number of impeller blades and the opperating speed a blade passing whistle frequency of 1200 Hz will be easily heard, and therefore care must be taken to minimise it at source by angling the struts 20.

By keeping an even number of impeller blades, to facililate manufacture, and by maintaining the speed of the fan low together with the angled motor support struts this results in an acceptably low noise level to the wearer of the respirator. In the prefered arrangement there are 12 impeller blades, providing an even balance of the moulded impeller. However the fixed diffuser may have an uneven number of blades e.g. 13 as this does not require to be balanced. The use of a high prime number of diffuser blades means that the final noise generated at the outlet of the fan is both small in magnitude, since there is only one impeller blade passing one diffuser blade at any one time, and virtually inaudible since at 6,000 revollutions per minute the interaction frequency is 15,600 Hz which is inaudible to most people.

With reference now to the embodiments shown in Figures 5 to 7 there is illustrated a comprehensive power pack for the positive pressure respirator mounted in a moulded rubber belt 21. The belt has eight rechargable nickel cadmium cells arranged in series to form a battery and moulded into the belt at 22 and are positioned so that when the belt is strapped to the wearer they are located at sides of the wearer's body. This allows the wearer to bend forwards, sit and work in confined spaces with the minimum of encumbrance. On/off switches 23 are moulded into the belt so that they are positioned at the front left hand side when worn by the wearer. These switches are fully sealed against adverse atmospheric conditions.

The power pack is connected to the repirator facepiece by an electric wire 24 with moulded connecting plug 25 at it end. The plug has a bayonet connection 26 to minimise the risk of accidental removal. The rubber belt is moulded with a section 27 of reduced thickness to provide a degree of elasticity for ease of movement and to grip the body of the wearer.

The belt is provided with a metal buckle 28 and buckle pin 29 which are wired to the battery cells and act as charging contacts. A wall mounted electrical charging unit 30 is illustrated in Figure 7 which has suitable electric contacts 31 and 32 to engage with the buckle 28 and buckle pin 29 respectively when the belt is hung on the charging unit when not in use. The wall mounted charging unit can have an indicator light 33 to show whether the unit is in the

charging or 'not ready' condition. The unit may also be provided with a name or number panel (not shown) and the required transformer/electronic. An alternative arrangement would be to provide a charging input beneath the switches 23 to accommodate a standard type plug.

The combination of the cells in series and the "sealed for life" arrangement of the belt ensure that the battery pack is maximised and the chances of dangerous mishaps which can occur when nickel cadmium cells are conected in parallel are avoided without having to resort to individial cells of large diameter in the belt.

The respirator may be provided with a warning indicator light set into the housing of the air filter unit 7, in the users line of sight, which lights up should the respirator fail to function, as might occur if the filter becomes clogged, the pump ceases to function or the battery cells run low. When the warning indicator lights up the user would leave the dangerous enviroment as quickly as possible.

It will be appreciated that the respirator of the present invention is of compact design, lightweight and meets the necessary safety requirements.

CLAIMS

1. A power assisted positive pressure respirator of the type set forth, comprising an air filter unit and a power driven pump secured directly to the respirator face mask, wherein the pump includes an impeller housing, a fixed vane diffuser coaxial to and co-operating with a centrifugal impeller, the diffuser being fixed to the impeller housing and the centrifugal impeller being driven by a motor located oxially within the impeller housing such that the noise of the power driven pump is reduced to a minimum acceptable within operational safety requirements.

2. A power assisted respirator as claimed in claim 1, wherein the filter is replaceably mounted at the inlet of a path for air in a housing closed by a perforated screw cap at the outer front extremity of the respirator face mask.

3. A power assisted respirator as claimed in claim 1 or 2, wherein the motor driven impeller rotates at between 7,500 and 9,000 revolutions per minute.

4. A power assisted respirator as claimed in claims 2 or 3, wherein the motor is mounted to the housing by three support the housing by three support struts angled with respect to the impeller blades to minimise tonal noise at the blade passing frequency.

5. A power assisted respirator as claimed in any preceding claim, wherein the impeller is driven from a power supply comprising a low current motor powered by a long life battery pack.

6. A power assisted respirator as claimed in claim 5, wherein the batteries are nickel cadmium cells arranged in series in a holder in the form of a belt.

7. A power assisted respirator as claimed in claim 6, wherein the belt is made of rubber and is used in conjunction with a rechargeable unit.

8. A power assisted respirator as claimed in any of claims 2 to 7, wherein the motor is located in the inlet of the airflow path downstream of the impeller, for cooling purposes.

9. A power assisted respirator as claimed in any preceding claim, wherein a warning indicator light is located on the air filter unit in the line of sight of the wearer to indicate a failure in the respirator system.

10. A power assisted positive pressure respirator substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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